November 1986

Town of Hudson
Groundwater Protection Study

Metropolitan Area
Planning Council
110 Tremont Street
Boston, MA 02108

HUDSON

GROUNDWATER PROTECTION

STUDY

NOVEMBER 1986

METROPOLITAN AREA PLANNING COUNCIL
BOSTON, MASSACHUSETTS

ABOUT THIS REPORT

This report was prepared by the staff of the Metropolitan Area Planning Council under the supervision of the Executive Director. The Metropolitan Area Planning Council is the officially designated regional planning agency for 101 cities and towns in the Boston metropolitan area. The Council offers technical assistance to its member communities in the areas of land use, housing, environmental quality, energy, transportation, and economic development.

This project has been financed in part with Federal funds from the Environmental Protection Agency to the Department of Environmental Quality Engineering under grant number C250000211. The contents do not necessarily reflect the views and policies of EPA or of DEQE, nor does mentions of trade names or commercial products constitute endorsement or recommendation for use.

Copies of this report may be obtained from:

MAPC Resource Library
110 Tremont Street
Boston, Massachusetts 02108

Credits

Project Manager:	Martin Pillsbury
Research Assistant:	Linda Smith
Technical Review:	Brian Barber
Graphics:	Cindy Harris
Word Processing:	Anna Maria Fantasia

HUDSON GROUNDWATER PROTECTION STUDY

TABLE OF CONTENTS

List of Tables

List of Figures

CHAPTER 1

BACKGROUND AND SUMMARY

This technical assistance report was prepared at the request of the town of Hudson, whose officials have expressed interest in protecting the town's water supply sources. Hudson meets most of its water supply needs with local sources of groundwater, supplemented by surface water from Gates Pond in Berlin. Hudson is a developing suburban community of about 16,500; at present about 24 percent of the watersheds containing water supply sources are developed. This study addresses the need for improved local protection measures to insure the quality and quantity of the town's public water supply. It examines the adequacy of existing local regulations to protect sources of water supply, and makes recommendations for developing a comprehensive water supply protection program which can be carried out at the local level.

The study area for this report includes those watersheds within the Assabet and Sudbury River basins which contain public water supply wells (see Figure 1-1). This includes two subbasins in the eastern portion of Hudson, an area of about 1770 acres, or 23 percent of the total land area of the town. Within this area there are three wells and a potential well site of concern. The boundaries of the recharge areas of these wells have not been determined, but since all polluting activities within the watersheds could potentially affect the water supply sources, the watershed boundaries were used to define the study area.

The overall methodology of this study included the following steps:

- o inventory the water resources of the town and identify areas of particular significance to the quantity and quality of the water supply;

- o inventory existing land uses and potential sources of groundwater contamination in the study area, and assess their potential threat to the quality of the water supply;

- o analyze the zoning of undeveloped land within the study area and determine the extent to which new permitted land uses could affect the water supply in the future;

- o recommend additional water supply protection measures to mitigate the potential land use and zoning impacts identified in the study.

All of the findings and recommendations were reviewed by a town Groundwater Study Committee, which met throughout the course of the study and provided valuable information and guidance. The committee is comprised of representatives of the Board of Selectmen, the Water Department, the Planning Board, the Board of Health, the Conservation Commission, and the Industrial Commission. The MAPC representative also served on the committee and acted as the liasion between the town and MAPC.

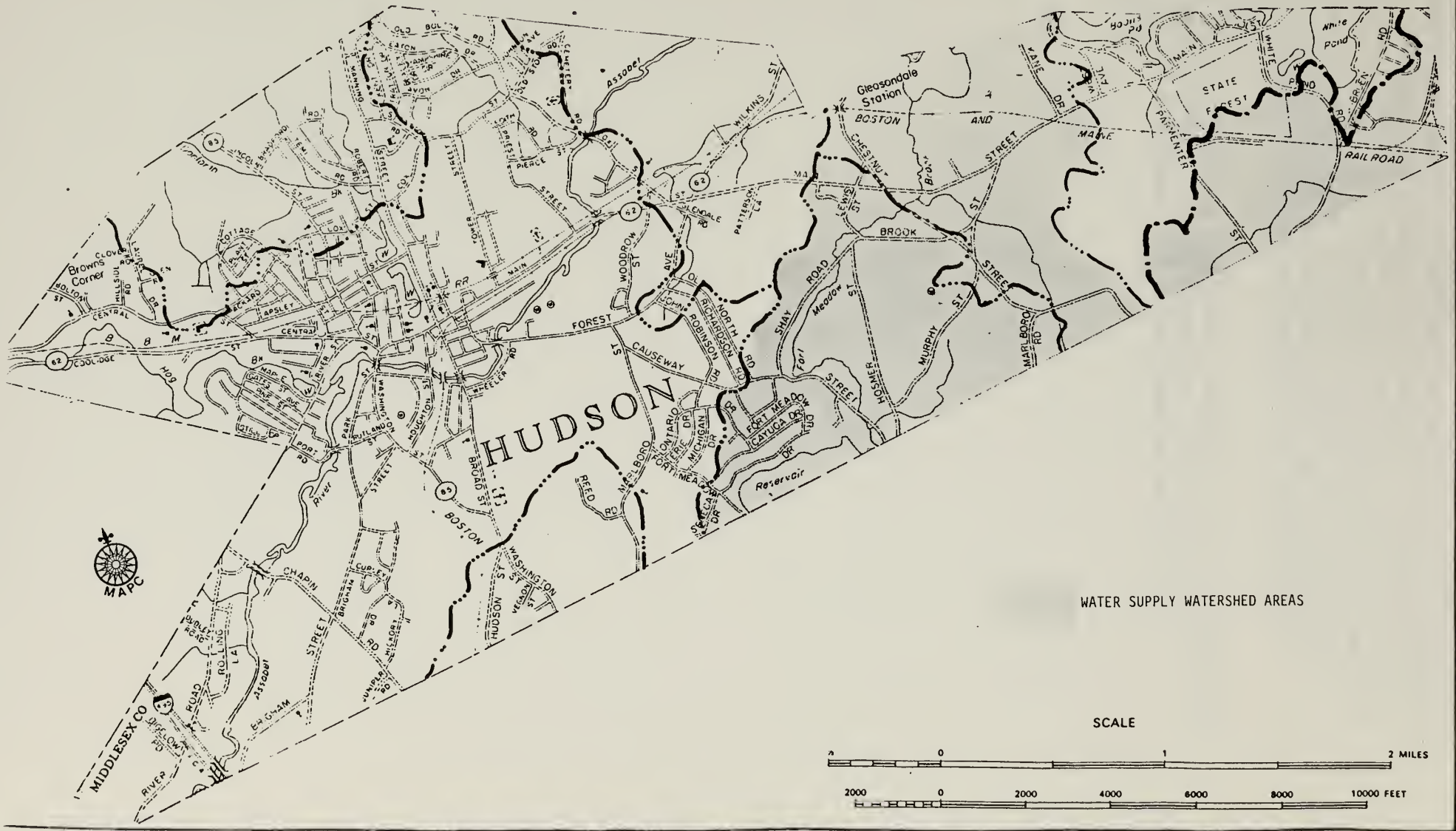
Protection of the water supply sources is vitally important in Hudson because all drinking water comes from local sources, and there are few if any practical alternative supply sources available to the town. Other towns in the region have experienced contamination and supply shortages, and the Massachusetts Water Resources Authority cannot be considered an alternative, except in an emergency. Hudson's ability to remain self-sufficient in water supply may depend upon how the town manages existing and future development in its water supply watersheds. Hudson has a number of policies which currently contribute to the protection of the town's water supply sources. For example:

- o the town owns about 167 acres of land around its three regular production wells;
- o the town's zoning bylaw includes a wetland and floodplain overlay district;
- o the town has a Hazardous Materials bylaw;
- o management of the landfill is being carried out with groundwater monitoring and protection measures;
- o the town is currently investigating the small amounts of organic chemicals found in municipal wells through a state grant under the Contamination Correction Program.

This study has examined land uses, zoning, and regulations in the town and has identified areas requiring additional protection to insure the long term quality of the groundwater resources. This has led to a set of recommendations for augmenting and strengthening town policies and regulations for managing activities within the watersheds. The major elements of this program include:

- o a zoning amendment to establish a Watershed Protection District overlay zone in the watersheds of the three municipal wells;
- o adoption of an underground fuel storage bylaw, which would strengthen existing regulation of the location, installation, and maintenance of underground fuel tanks;
- o an amendment to the Earth Removal regulations requiring that excavation be no deeper than ten feet above the seasonal high water table;
- o groundwater monitoring to insure that existing industries and a junkyard do not impact the municipal wells.

FIGURE 1-1


HUDSON
Gleasondale Station
BOSTON AND MAINE RAIL ROAD
Browns Corner
MIDDLESEX CO
MAPC
WATER SUPPLY WATERSHED AREAS
SCALE
2 MILES
10000 FEET

Implementation of the recommended program will require the cooperation and support of several town boards, as well as town meeting support for new or amended bylaws. An important element for successful implementation will be public education. The Groundwater Study Committee may assist in these efforts, which may include public meetings and presentations, as well as development of brochures or other educational materials. Increasing public awareness of groundwater protection will be as important as modifying local regulations in meeting the goals of the groundwater protection program.

In the chapters that follow, the background, analysis, and the recommended plan are presented in detail. It is hoped that this study will assist the town of Hudson in the development of a comprehensive water supply protection program.

CHAPTER 2

WATER SUPPLY SYSTEM PROFILE

Prior to examining the protection needs of Hudson's groundwater resources, it is useful to have an overview of the elements and operation of the water supply system. This will aid in formulating a protection plan which is responsive to the needs of the town.

WATER USE AND CONSUMPTION

The Hudson Department of Public Works supplies water to approximately 15,000 people, or about 91 percent of the town's population. There are approximately 3,500 residential connections in the system. In 1984 the system delivered a total of 739 million gallons, with an average day demand of 2 million gallons per day and a maximum day demand of 2.6 mgd. The safe yield of existing sources is about 2.75 mgd, excluding emergency sources. Water use in the town falls into the following major categories: residential (37%), commercial and industrial (20%) and unaccounted-for (43%).

Over the last ten years, average day demand has fluctuated between 1.74 and 2.19 mgd. Maximum day demand has varied between 2.62 and 3.27 mgd. For the last 5 years it has remained below 3 mgd. (See Table 2-1 and Figure 2-1).

Table 2-1 Historic Water Use: Average and Peak Day Use

Year	Average Day (Mgd)	Peak Day (Mgd)
1985	2.02	2.96
1984	1.82	2.64
1983	1.85	2.70
1982	2.08	2.71
1981	2.19	2.59
1980	2.04	3.27
1979	1.77	3.10
1978	1.80	2.62
1977	1.94	2.65
1976	1.86	3.25
1975	1.74	2.83

Projections of future water demand made in previous reports to the town estimated that by 1990, the average day demand would rise to 3 mgd, and the peak demand to 5 mgd. However, those projections were based on an assumption that the town's 1990 population would be 23,400. It is now apparent that population will be much lower. MAPC's projection is for a 1990 population of 18,500. Water demand would be accordingly lower, probably remaining close to its current level.

Groundwater is the major source of public water supply in Hudson. The town operates three gravel pack wells with a combined safe yield of 2.4 mgd. (see Table 2-2). This represents 87 percent of the town's supplies. In addition, the town uses one surface water reservoir, Gates Pond, located in Berlin. This provides an additional 0.35 mgd, or about 13 percent of the total supply of the town. (See Table 2-3).

Table 2-2 Public Supply Wells

	Chestnut St.	Kane	Cranberry	Rimkus*
Well type	Gravel Pack	Gravel Pack	Gravel Pack	Gravel Pack
Diameter		24"	24"	12"
Depth		45'	48'	52'
Static level		14'	24'	38'
Year installed	1982	1965	1966	1952
Safe Yield (mgd)	1.0	0.5	0.9	0.5*

*Rimkus used as emergency back-up source only.

Table 2-3 Public Water Sources

Source	Safe Yield (mgd)	Percent
Chestnut St. Well	1.0	36%
Cranberry Well	0.9	33%
Kane Well	0.5	18%
Gates Pond	0.35	13%
TOTAL	2.75	100%

Historic water use trends of each of the town's sources is shown in Table 2-4. The table shows that since 1982, use of Gates Pond has dramatically decreased, while use of groundwater has increased with the opening of the Chestnut Street well.

Table 2-4 Historic Water Use by Source
(million gallons)

	Gates Pond	Kane Well	Cranberry Well	Chestnut Well	Rimkus Well	Marlboro Connection	TOTAL
1984	36	105	252	345	---	---	739
1983	33	125	164	320	24	---	666
1982	10	110	238	87	53	85	676
1981	195	171	309	---	39	46	761
1980	291	190	305	---	14	---	800
1979	229	185	329	---	---	---	743
1978	161	165	319	---	---	---	645
1977	175	189	294	---	---	---	658
1976	206	160	342	---	---	---	708
1975	191	194	295	---	---	---	680
1974	193	162	280	---	---	---	635
1973	179	171	248	---	---	---	598
1972	202	112	245	---	---	---	559

EMERGENCY SOURCES

The town operates the Rimkus well as an emergency supply source to supplement the system when demand exceeds the regular supply sources. The well was taken out of regular production because of high iron content, which is primarily a taste and odor problem. During the dry period of the early 1980's, the well provided between 14 to 52 million gallons per year. The Rimkus well has a safe yield of about 0.5 mgd.

The town may also purchase supplementary water from the City of Marlborough through an emergency connection. Water from this source was also used during the 1981-83 drought.

The town has also expressed interest in exploring the possibility of connecting to the private water supply of Digital Equipment Corporation for emergency use.

WATER QUALITY

The quality of Hudson's drinking water meets all standards established under the Safe Drinking Water Act. The quality of each source of water is tested periodically according to state and federal requirements. Table 2-5 summarizes the water quality data for each of the town's water sources. In addition to the standard drinking water quality tests required by law, the town's water has been tested for two common organic chemicals, trichlorethane and trichlorethylene. These tests revealed trace amounts of trichlorethane in the Kane and Rinkus wells and trichlorethylene in the Cranberry and Rimkus wells (see Table 2-5). The amounts found are far below the EPA's current standards of 1000 parts per billion (ppb) for trichlorethane and 75 ppb for trichlorethylene. However, under recent amendments to the Safe Drinking Water Act, the standards may be lowered to 200 ppb and 5 ppb, respectively.

Another organic chemical, dichloropropane, has been found in small amounts in the new Chestnut Street well. Periodic testing is ongoing, and levels of contamination vary between about 2 to 7 parts per billion. As a result of this contamination, the town is conducting a study to determine the source of contamination, funded by the state's Contamination Correction Program. The study includes detailed on-site inspections of all industries in the vicinity of the well, and a series of monitoring wells installed in the aquifer area.

The existence of these organic chemicals in the wells, although in small quantities, indicates the potential danger of industrial land uses in the aquifer area.

This issue will be addressed in Chapter 4 of this study, and in the study's recommendations.

WATER TREATMENT

Because the quality of the raw water sources is generally good, minimum treatment of Hudson's water is needed. Water from Gates Pond is treated with chlorine for disinfection, as all surface water supplies are. Metaphose (a softener) and HDH are added at the pumping stations. The new Chestnut Street well is set up for treatment with zinc ortho-phosphate.

It should be noted that none of these treatment technologies is capable of removing contaminants such as metals, gasoline, and volatile organic chemicals. It is therefore necessary to prevent the introduction of these substances into the surface and groundwater sources of the town. This study will evaluate such risks to the town's water supply, and recommend steps the town can take to protect its aquifers from such contamination.

STORAGE

The Hudson Water Supply System includes four storage facilities, which have a combined capacity of 3.8 million gallons. This represents about two days' supply at average withdrawal rates, and a little more than one peak day's demand. The facilities are: Potash Hill (1.3 mg), Murphy Road (1.0 mg), Popes Hill (1.0 mg), and Round Top (0.5 mg).

Because the storage facilities provide only short-term storage equal to one or two days' demand, they would be of limited value to compensate for lost water in the event of the contamination of a major source of supply.

POTENTIAL FUTURE SOURCES

The town's water supply consultant has investigated various parts of town in search of additional aquifers capable of yielding significant quantities of water. The area north of Main Street and east of Chestnut Street appears to be the most promising. The Chestnut Street Well was recently installed there, and it is believed that the aquifer may be able to support the development of two additional wells yielding about 1 mgd each. Since more than half of the town's existing supply comes from this area, and it is possibly the only favorable area for future well development, this aquifer area should be considered the highest priority area for protection.

Table 2-5
Drinking Water Quality (May 1985)

	Gates Pond	Cranberry Well	Kane Well	Chestnut St. Well	Rimkus Well
Turbidity	0.6	0.8	0.3		
Sediment	0.0	0.0	0.0		
Color	15.0	5.0	5.0	NA	NA
Odor	0.0	0.0	0.0		
pH	6.7	6.1	6.2		
Alkalinity-Total (CaCO3)	10.0	7.0	8.0		
Hardness (CaCO3)	20.0	19.0	32.0		
Calcium (Ca)	5.9	5.2	9.1		
Magnesium (Mg)	1.1	1.4	2.2		
Sodium (Na)	4.5	11.0	17.0		
Potassium (K)	1.1	1.0	2.4		
Iron (Fe)	0.05	0.0	0.11		
Manganese (Mn)	0.00	0.09	0.09		
Sulfate (SO4)	12.0	15.0	14.0		
Chloride (Cl)	6.0	15.0	24.0		
Spec. Cond. (micromhos/cm)	65.0	99.0	163.00		
Nitrogen (Ammonia)	0.02	0.02	0.02		
Nitrogen (Nitrate)	0.1	0.2	2.2		
Nitrogen (Nitrite)	0.001	0.001	0.001		
Copper (Cu)	0.00	0.08	0.33		
Trichlorethane* (ppb)	------	0.0	3.9	0.0	1.4
Trichlorethylene* (ppb)	------	15.0	0.0	0.0	1.0

CHAPTER 3

WATER RESOURCES AND ENVIRONMENTALLY SENSITIVE AREAS

This chapter describes the characteristics of the natural environment within the town of Hudson and their significance to the drinking water supplies. The areas addressed are: watershed areas, topography and geology, groundwater resources, wetlands, and soils. Characteristics of the built environment are presented in Chapter 4.

WATERSHED AREAS

The town of Hudson is within the Assabet and Sudbury River watersheds. The study area for this water supply protection study is comprised of the three subbasins that the Kane, Cranberry, and Chestnut Street wells are located within (See Figure 3-1). The reasons for using the watershed boundaries as the principle focus of the study area are:

- they delineate the area within which land use and development activities may affect drinking water sources, making them meaningful geographic units by which to manage water;
- their delineation is based on topography which is straightforward and defensible; and
- more detailed hydrogeological data is not available to precisely define the groundwater recharge areas within the watersheds.

The entire town will be surveyed for land use trends and contamination sources and impacts on the water supply with emphasis on the following three subbasins containing the public water supply wells:

- the watersheds of the Ft. Meadow Brook and an unnamed tributary, which contain the Chestnut Street and Kane wells;
- a portion of the Sudbury River watershed in the southeastern corner of Hudson which contains the Cranberry well.

Total land area in the town is 7680 acres, with approximately 1770 acres or 23 percent of the town, falling into the above three subbasins.

TOPOGRAPHY AND GEOLOGY

The topography of Hudson consists of low, generally rounded hills and open valleys which have been modified by glaciation. Elevations range from approximately 200 feet above mean sea level in the Valley of the Assabet River to over 400 feet on several hills in the town. Surface drainage generally is to the east by way of the Assabet River and its tributaries, with the exception of a small area in the southeastern corner of town which drains to the Sudbury River.

The bedrock geology of the town consists mostly of Gospel Hill gneiss, which is a medium to coarse-textured granit gneiss. The eastern edge of Hudson is transected by the Marlboro formation, composed of fine-grained schist. South of the town center is a small formation of Straw Hill diorite. The town's bedrock formations lie mostly less than 50 feet below the ground surface.

The bedrock is overlaid by surface deposits consisting of glacially derived till and stratified sand and gravel. Postglacial deposits include wind-blow sand and silt, alluvium, and swamp deposits.

Most of the glacially-derived sand and gravel was deposited as kames, kame fields or terraces, or outwash plains. Much of the till was deposited as ground moraine and drumlins. Most of the sand and gravel deposits lie at the lower elevations, while many of the till deposits form the higher topographic features.

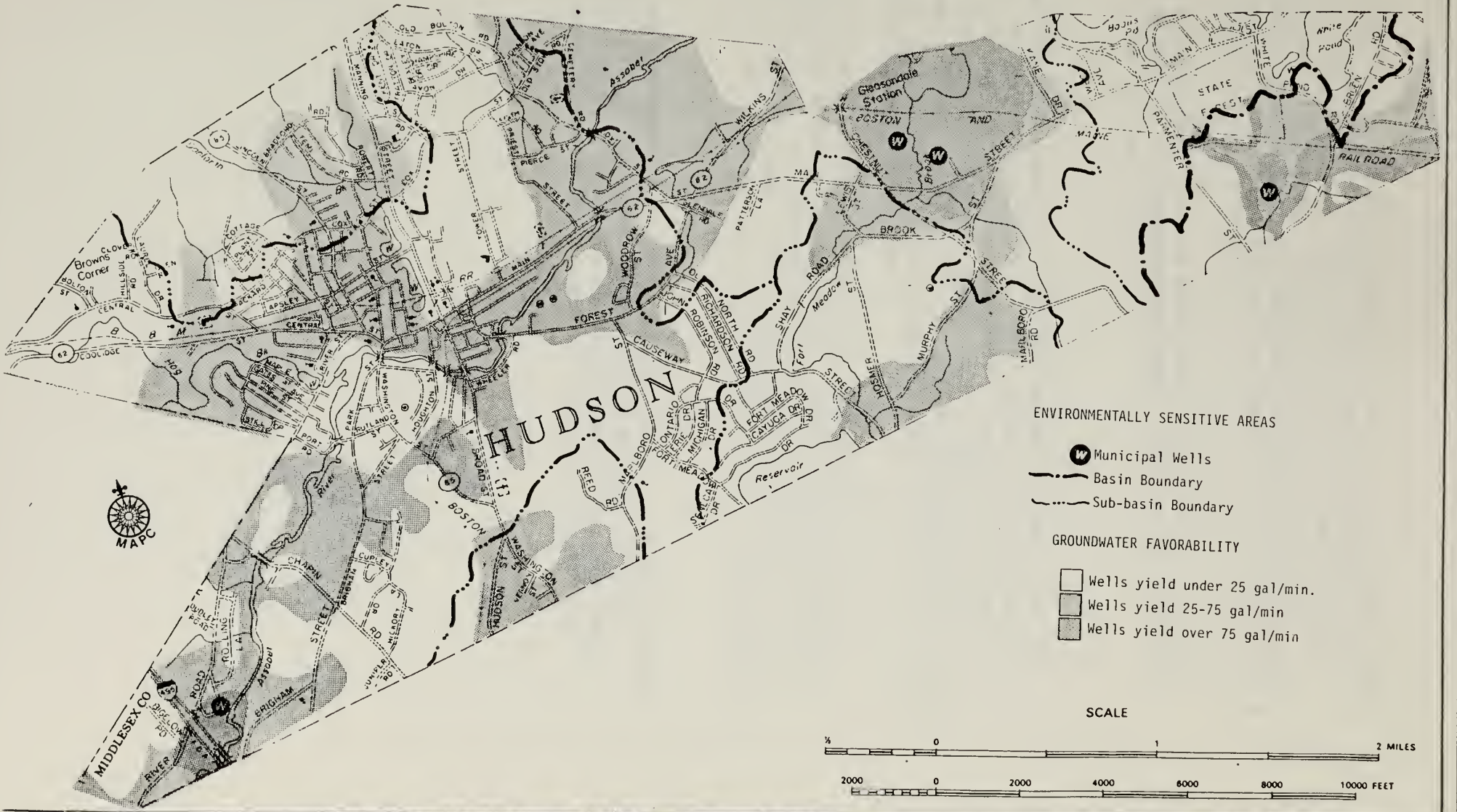
GROUNDWATER RESOURCES

The occurence of groundwater in the town is controlled by surficial and bedrock geology. Aquifers which yield sufficient quantities of groundwater for public water supply are generally found in thick deposits of glacially deposited stratified sands and gravels, which are capable of storing and transmitting significant quantities of water. The thickest areas of such permeable deposits are generally found in "buried valleys," with depressions in the bedrock corresponding to former (pre-glacial) stream channels. According to the USGS Hydrologic Atlas, the most favorable aquifer areas, which are potentially capable of yielding more than 75 gallons per minute, underlie about 370 acres of the water supply watersheds. The town's three wells are located within these areas. In addition to the high yield aquifers, about 570 acres of moderately favorable aquifers are located within the watersheds; these areas have an estimated potential yield of 25 to 75 gallons per minute. Taken together, the high and medium yield aquifer areas comprise 943 acres, or about 12 percent of the town, and about 53 percent of the water supply watershed areas.

Figure 3-1 does not show the aquifers' "recharge areas," or the surface area that contributes water and replenishes the aquifers. No data sources were found which delineate aquifer recharge areas for Hudson. Site-specific hydrogeologic studies would be necessary to identify specific areas which contribute to the recharge of the town's wells. However, the recharge areas would be within the watershed boundaries which define the study area.

However, groundwater modelling was conducted for the existing Chestnut Street well by the town's engineering consultant. This analysis estimates the area which contributes to the well under pumping conditions. The area is estimated to be bounded by Chestnut Street to the west, by Fort Meadow Brook to the south and east, and by the Assabet River to the north.

FIGURE 3-1


HUDSON
MAPC
ENVIRONMENTALLY SENSITIVE AREAS
Municipal Wells
Basin Boundary
Sub-basin Boundary
GROUNDWATER FAVORABILITY
Wells yield under 25 gal/min.
Wells yield 25-75 gal/min
Wells yield over 75 gal/min
SCALE
2 MILES
10000 FEET

CHAPTER 4

LAND USE AND WATER SUPPLY IMPACTS

This Chapter describes the uses of land in the town of Hudson, and examines the potential impacts of land use on the quality and quantity of water supply sources in the town. After a brief review of the recent growth and development trends of the town, water supply impacts will be addressed in terms of the potential sources of contamination associated with each land use.

HISTORIC DEVELOPMENT TRENDS

This section reviews the last three decades of growth and development in Hudson. This perspective aids in understanding the existing land uses, as it provides information on past activities which today may affect the water supply sources.

The data on historic land use was taken from a study by Williamm MacConnell at the University of Massachusetts, who has classified and mapped land uses by interpretation of aerial photography. The minimum parcel size mapped was three acres. MacConnell analyzed land use changes in 1951, 1971, and 1980. Table 4-1 summarizes the population and population density of Hudson between 1950 and 1980.

Table 4-1
Population Data 1950-1980

Year	Population	Population Density (person/sq. mi.)	% Change
1950	8,211	684	---
1960	9,666	805	18
1970	16,084	1,340	66
1980	16,408	1,367	2

The data shows that the population has doubled in thirty years. However, the population has stabilized in the most recent decade, with almost all of the growth occurring between 1950 and 1970.

The rapid population growth in Hudson is reflected in the changing land uses in the town over the last 30 years. Table 4-2 shows the breakdown of land uses for 1951 and 1980. Of note is that "developed" land uses more than doubled from 1288 to 3120 acres. The largest gain in acres was residential, which increased 1263 acres. The 35.6 percent growth of industry was the largest percentage growth. "Undeveloped" land uses dropped 1492 acres or 28.2 percent. The largest loss was agricultural which dropped by 1294 acres or 69 percent.

Table 4-2
Hudson Land Use Change, 1951-1980

Land Use	1951 Acres	1980 Acres	Change Acres	Percent Change
Residential	955	2218	+1263	+132
Industrial	51	233	+182	+356
Commercial	63	203	+146	+231
Open & public	186	173	+13	-7
Transportation	33	81	48	+145
Mining	--	111	--	--
Outdoor Recreation	--	45	--	--
Waste Disposal	--	56	--	--
Total Developed Land	1288	3120	+1832	142%
Forest	3693	3346	-347	-9
Wetland	483	435	-48	-10
Open	176	86	-90	-51
Agriculture	1855	561	-1294	-69
Water	145	132	-13	-9
Total Undeveloped Land	6352	4560	1792	-28.2

SUMMARY OF EXISTING LAND USE

The current land use within the town have been classified for analysis and mapped in Figure 4-1. Table 4-3 shows the breakdown of land use for 1980. Hudson is 40.6 percent developed, of which 28.9 percent is residential with 3.0 percent industrial and 2.6 percent commercial. About 59.4 percent of the land is undeveloped, of which 43.6 percent is forested, the balance wetlands, agriculture and open space.

FIGURE 4-1

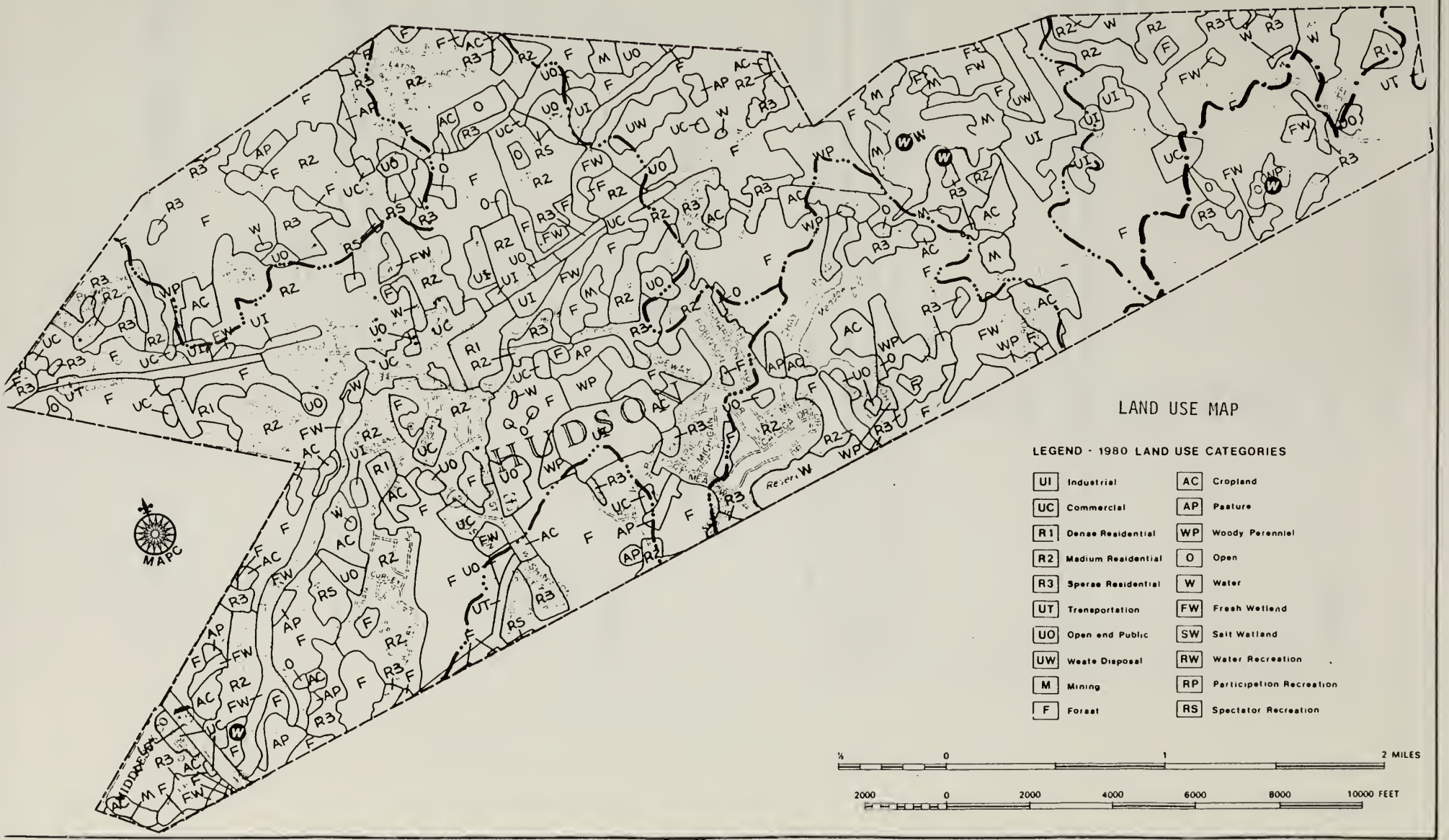

HUDSON
MAPC
LAND USE MAP
LEGEND - 1980 LAND USE CATEGORIES
UI Industrial
UC Commercial
R1 Dense Residential
R2 Medium Residential
R3 Sparse Residential
UT Transportation
UO Open and Public
UW Waste Disposal
M Mining
F Forest
AC Cropland
AP Pasture
WP Woody Perennial
O Open
W Water
FW Fresh Wetland
SW Salt Wetland
RW Water Recreation
RP Participation Recreation
RS Spectator Recreation
½ 0 1 2 MILES
2000 0 2000 4000 6000 8000 10000 FEET

Table 4-3
Hudson Land Use, 1980

Land Use	Acres	Percent
Residential	2218	28.9
Industrial	233	3.0
Commercial	203	2.6
Open & Public	173	2.3
Transportation	81	1.1
Mining	111	1.4
Waste Disposal	50	.7
Outdoor Recreation	45	.6
Developed Land - Subtotal	3120	40.6
Forest	3346	43.6
Wetlands	435	5.6
Open	86	1.1
Agriculture	561	7.4
Water	132	1.7
Undeveloped Land - Subtotal	4560	59.4
Total	7680	100.0

For the water supply watershed areas, land uses are tabulated in table 4-4.

Table 4-4

Hudson Water Supply Watershed Areas
Land Use 1980

Land Use	Acres	Percent
Residential	232	13.0
Industrial	65	3.6
Transportation	4	0.3
Mining	75	4.2
Waste Disposal	18	1.0
Commercial	4	0.3
Open and Public	19	1.1
Developed Land - Subtotal	417	23.5
Forest	912	51.3
Wetlands	221	12.4
Agriculture	208	11.7
Open	19	1.1
Undeveloped Land - Subtotal	1360	76.5
Total	1777	100.0

Nearly one half of the watershed area remains forested,and nearly three quarters is in an "undeveloped" land use type. Of the 23.5 percent of the watershed which is developed, the majority, or 13 percent, is residential. However, there are industrial, commercial, waste disposal, mining, and transportation land uses which comprise a total of 166 within the watershed area. These uses could pose a potential threat to water supplies because of their proximity to the municipal wells. The potential impacts of such land uses is examined in the following section.

LAND USE/WATER SUPPLY IMPACTS

Land uses within the water supply watershed can affect both water quality and water quantity through physical alteration of the environment which changes drainage patterns and rates of runoff and recharge, and through discharge of contaminants to surface or groundwater. In this chapter, the potential impacts of land uses on water supplies are analyzed in terms of the physical alterations and chemical contaminants associated with each. For each of these potential sources of contamination, the analysis presents:

- the characteristics and water supply impacts;
- the land uses associated with each;
- existing conditions in Hudson describing the prevalence of these land uses within the water supply watershed;
- existing regulations and practices; and
- recommendations for improved management or regulation for water supply protection.

The potential sources of contamination addressed are: underground fuel storage tanks, wastewater, road salt, leachate, hazardous wastes, pesticides, mineral extraction which are mapped in Figure 4-2.

As can be seen in Table 4-4 approximately 76 percent of the study area is undeveloped. This land has potential for future development. Such primarily undeveloped property provides a natural recharge area for groundwater and surface water and this has no adverse effect on either the quantity or quality of drinking water supplies. The developed land uses in the remaining 24 percent of the watersheds have the potential to cause impacts on the quantity and quality of water supply in Hudson. The relationship between land uses and potential drinking water impacts is summarized in Figure 4-3 and described in detail below.

FIGURE 4-2

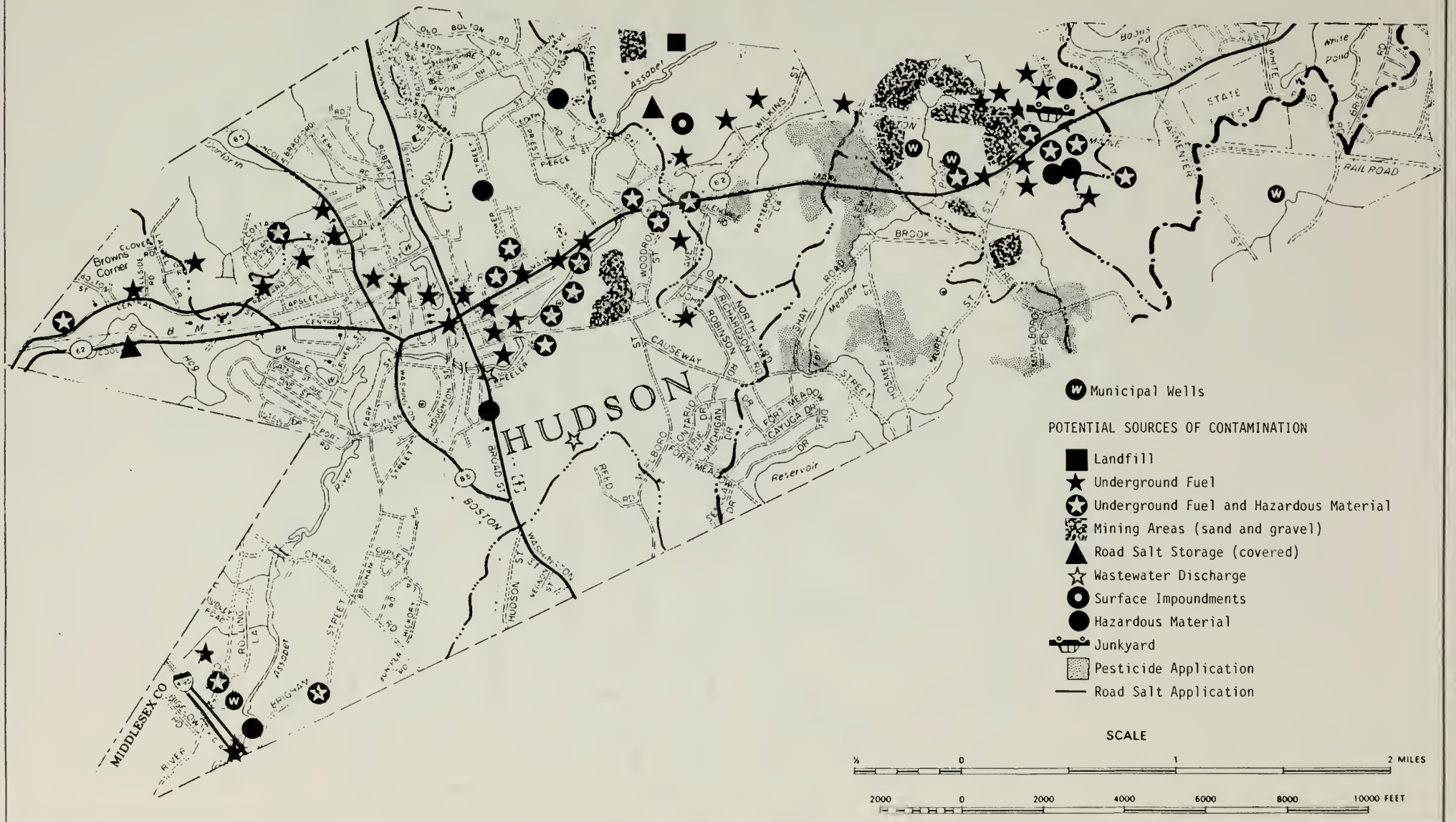
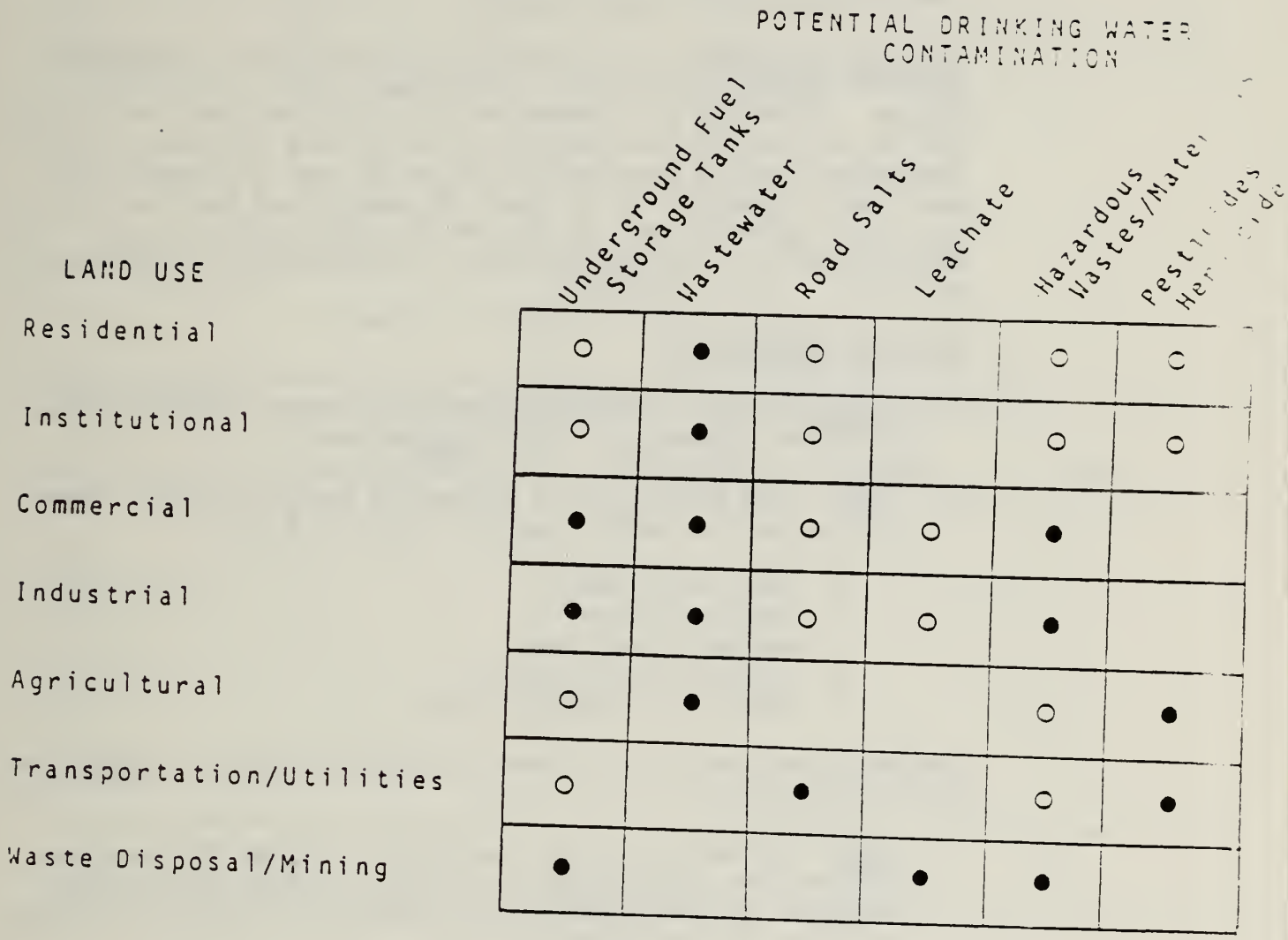

HUDSON
MIDDLESEX CO
Municipal Wells
POTENTIAL SOURCES OF CONTAMINATION
Landfill
Underground Fuel
Underground Fuel and Hazardous Material
Mining Areas (sand and gravel)
Road Salt Storage (covered)
Wastewater Discharge
Surface Impoundments
Hazardous Material
Junkyard
Pesticide Application
Road Salt Application
SCALE
½ 0 1 2 MILES
2000 0 2000 4000 6000 8000 10000 FEET

Figure 4-3

EFFECTS OF LAND USES ON WATER SUPPLY SOURCES



1. Underground Fuel Storage

a. Potential Impacts. Leakage of tanks or piping which are subject to corrosion or puncturing. Unprotected steel tanks have an average life expectancy of 15 years in corrosive soils. Most soil types in Massachusetts are corrosive. Once it leaks, gasoline can move through the ground and contaminate public or private wells. A small amount of fuel can contaminate much water, since concentrations of more than several parts per billion are considered unsafe.

b. Land Use Associations. Fuel storage is typically associated with service stations, fuel companies, auto dealerships, public works facilities, bus and truck fleets, schools, churches and other institutions, and at residences where large underground tanks are installed for additional storage.

c. Existing Conditions. There are 54 facilities with underground gasoline storage, and 62 with underground fuel oil storage in Hudson. According to licenses on file with the town clerk, 44 of the 54 gasoline storage permits are 15 or more years old. Fire Department records show that 25 of the 62 fuel oil permits are more than 15 years old. At least 18 underground fuel facilities are within one-half mile of one of the public supply wells. Underground fuel storage facilities are summarized in Tables 4-7 and 4-8.

d. Existing Regulations.

- Federal - EPA is developing new requirements which will set minimium standards for state regulations.

- State - The Board of Fire Prevention Regulations has issued new regulations which require: (527 CMR 9.00)

    - tank registration
    - inventory control
    - non-corrosive tanks
    - periodic tank testing
    - removal of abandoned tanks

  However, these regulations exempt residential and farm tanks less than 1100 gallons.

- Town - The Board of Selectmen issues licenses for gasoline storage over 165 gallons and fuel oil storage over 10,000 gallons. The Fire Dept. issues permits for fuel oil storage less than 10,000 gallons.

Table 4-5

Summary of Underground Fuel Licenses---Gasoline

Age of Permit	Amount of Fuel Storage Permitted (Gallons)					
	1000	1000-6000	6000-12000	12000+	Unknown	Total
0-5						0
5-10			3			3
10-15		2	2	3		7
15-20		2	1	4		7
20	1	30	3	1	3	37
Total	1	34	9	8	3	54

Table 4-6

Summary of Underground Fuel Permits--Fuel Oil

Age of Permit	Amount of Fuel Storage Permitted (Gallons)			
	0-999	1000-1999	2000+	Total
0-5	1	4	1	6
5-10	1	6	5	12
10-15	2	7	8	17
15-20	4	1	1	6
20+		1	18	19
Unknown		2		2
Total	8	21	33	62

Table 4-7
Underground Fuel Storage Licenses

Name & Address	License Date	Gasoline	Fuel Oil	Misc.
81 Apsley St. Hudson Lock	1944 ?		100,000 1,000	
113A Apsley Jays Auto Body	1930	?	?	
275 Brighem Paul E. Davis	1964	300		
43 Broad Independent Cable	1950		20,000	
167 Broad J. Princesteiner	1931	1,000		
87 Central Cumberland Farms	1965 1974 1947	8,000 22,000 2,500		
166 Central Frias Bros Service	1961	10,000 5,000 3,000		
265 Central Russel Auto	1950	5,000 5,000		
2 Chestnut Alan Menter	1979			500
Cooledge St. Murphy Oil	1961		40,000	
5 Colledge St. F. Casaceli	1973 1980	10,000 10,000		
275 Cox St. George McGee	1964 1953	2-5,000 2-5,000		
6 Houghton Everett Miller	1949	5,000		
60 Houghton Thomas Taylor & Sons	1949		15,000	
120 Main St. J & K Tire	1921 1930 1927 1933 1956	3,000 2-1,000		?

Table 4-7 (continued)
Underground Fuel Storage Lincenses

Name & Address	License Date	Gasoline	Fuel Oil	Misc.
123 Main	1931	3,000		
130-134 Main St.	1953/57			9,000
213 Main St.	1931	12,000		
Durand	1938	5,000		
159 Main St.	1958		8-10,000	
Knight Fuel				
181 Main St.	1960	?		
Shell Oil				
246 Main St.	1931	?	?	
Durand Chevrolet	1970	10,000		
420 Mian St.	1945	2-2,000		
Edmund Morel				
186 Main St.	1949	2-3,000		
AMD Realty Co.				
422 Main St.	1963			?
Shell Oil				
348-350 Main St.	1970	21,000	500	500
PC Petroleum	1974	40,000		
457 Mian St.	1930	?	?	
Exxon Corp.	1945	2,000		
	1965	16,000	500	
555 Main St.	1979	8,000		
Holzwassen Realty				
560 Main St.	1961	?	?	
Roger & Alden Kane				
Lot #17	1969	?	?	
Roger & Alden Kane				
Lot #14	1972	7,500		
Roger & Alden Kane	1972	2,000		
562 Main St.	1951	5,000		
Ricks Auto Parts				
706 Main St.	1952	?		
Samuel Goldman	1974	20,000		

Table 4-7 (continued)
Underground Fuel Storage Lincenses

Name & Address	License Date	Gasoline	Fuel Oil	Misc.
230 Manning St.	1947		9,980	
Telco Inc.	1947			
	1945	500		
1 Municipal Dr.	1979	10,000		
Town of Hudson				
17 Parmenter	?		2,000	
Channel 66				
37 PriestSt.	1962	?	?	
Carl Crouse				
75 Reed Rd.	1979	10,000		Hydrogen 180
Digital Equipment				
165 River St.	1939		4-10,000	
Farruccio				
446 River St.				
Major Machinery	1970	2,000		Waste 1,000
		1,000		
34 South St.	1959	?	?	
Murphy				
23 Washington St.	1950	2,000		
Donald Smith				
27 Washington	1984	?	?	
Rotary Texaco				
28 Washington	1978	5,000	550	
Parente Service Ctr.		21,000		
	1928	3,000		
153 Washington	1972	1,000		
Argro Cellucci				
173 Washington				
Bonmazzolli & Sons	1933	1,000	2,000	
	1932	10-10,000		
200 Washington	1970	16,000	1,000	Waste 1,000
Cumberland Farms				
Brigham Sand Pit	1938		3-1,000	
Thomas Walsh				

Table 4-7 (continued)
Underground Fuel Storage Lincenses

Name & Address	License Date	Gasoline	Fuel Oil	Misc.
Broad & Washington	1953	?	?	
Walsh	1963	?	?	
	1973	35,000		
Washington & Broad	1950	4-4,000	500	500 Waste
Gulf Oil				
Washington & Hudson	1930	?	?	
Felpo Corp.				
3 Zina Rd.				
Helen Zina	1950		300	

Table 4-8
Hudson Fuel Oil Storage Permits

Address	Permit Holder	Gallons	Date
Packard St.	Hudson School Dept.	5980	1956
Central St.	Hill Bros. Shoe Co.	2000	1956
15-17 Apsley St.	S. Shanberg	3000	1958
7 Howe St.	S. Shanberg	2000	1958
Main & High St.	Catholic High School	6830	1958
193 Central St.	A. Johnson	14000	1959
200 Manning St.	D. Hellen	1200	1961
416 Main St.	T. Murphy	2-2000	1962
		1-3000	1962
South St.	Hudson Combing Co.	10000	1962
Lincoln St.	D. Hellen	20000	1963
Parmenter Rd.	G. Burdick	2000	1963
	Intermediate School	15000	1963
High St.	St. Michaels Convent	6600	1963
Cherry St.	Hudson Ind. Realty Co.	1-20000	1964
		2-15000	
Tower St.	New England Tape	10000	1965
17 Edith Rd.	R. Milton	1000	1969
Brigham	Hudson High School	10250	1969
Broad & Washington	G. Purley	29400	1972
		4000	1972
Main St.	Garfield Corp.	10000	1972
193 Central St.	A. Johnson	4000	1973
Berant	Jayco Fiberglass	1000	1973
10 Hosmer	MacDonald	1000	1973
Main St.	Lake Boone Gen. Store	2-1000	1973
185 Brook St.	R. Knoght	1000	1973
5 Wilkens	E. Doane	500	1973
Main St.	Durand Chevrolet	3000	1973
*122 Murphy St.	P. Jensen	500	1974
Washington St.	Tucks	3000	1974
Cherry St.	Dougherty	4000	1974
Apsley & Warner	T. Verdon	500	1977
40 Cottage	Wm. Reynolds	1000	1977
189 White Pond Rd.	P. Hammer	1000	1978
*Edgewood Dr.	R. Butler	1000	1978
181 White Pond Rd.	J. Byra	1000	1978
Marlboro St.	Digital Corp.	20000	1978
193 Central St.	A. Johnson	10000	1979
46 River St.	F. Dubois	2000	1979
*128 Forest Ave.	C. McCarthy	2000	1979
471 Main St.	Tucker	1000	1980
177 Chestnut	T.C. Jensen	1000	1984
87 Mason	J & J Oil Heat	1000	1983
Murphy	P. Jensen	550	1981
Main & Glendale	Esso-Gilbert & Barker	500	1966
Main St.	Fire Dept.	500	1968
471 Main St.	J. Clarke	1000	?
17 Parmenter	Channel 66	2000	1985

Table 4-8 (continued)
Hudson Fuel Oil Storage Permits

Address	Permit Holder	Gallons	Date
30 Old No. Rd.	H. Salmela	500	1968
Parmenter	Econo Tennis	4000	1975
31 Richard Rd.	D. Jopling	1000	1979
31 Wilkens	Contronautics	500	1970
106 Brook	F. Bonazzoli	1000	1975
14 Brook	L. Letendre	1000	1985
Kane Industrial Park	Intress Co.	1000	?
88 Brigham	A. Pettitto	1000	1982

e. Recommendations. Due to the potential for contamination of the town's water supplies by leaking underground fuel tanks, the town should consider adopting a local underground fuel bylaw which would strengthen the existing regulations in three ways:

- require a permit from the Fire Department for those tanks less than 1100 gallons which are exempted by the current regulations. Most of these are residential and farm tanks.
- require periodic tightness testing for those tanks less than 1100 gallons which are located in the watershed protection district.
- establish a review process for all new underground fuel permits and licenses which allows the Water Department, Board of Health, and Conservation Commission to advise the permit-granting authority on any potential water supply impacts and suggest possible mitigation measures. Such review would be advisory only and in no way supercede the responsibilities of the permit granting authorities.

A proposed bylaw is included in Appendix A.

2. Wastewater

a. Potential Impact. Both surface water and groundwater supplies can be affected by problems associated with disposal of sanitary wastes. Failing septic systems can be caused by improper siting, installation or maintenance. Soil type, depth to bedrock and depth to the water table can be major factors in septic systems failures. Such failures can introduce excessive nutrients, chlorides, bacteria and household chemicals into soil which can then leach into water supplies. Industrial uses which rely on septic systems pose a special threat to groundwater quality.

b. Land Use Associations. Residential, commercial, and industrial land uses generate wastewater. These land uses occupy about 17 percent of the watershed area.

c. Existing Conditions. About 60 percent of the town is sewered, primarily in the western portion of town around Hudson center. However, the water supply watersheds in the eastern part of town are unsewered, thus relying on septic systems to treat sanitary wastes. Since much of this area is developed for industrial land uses, there is the potential for water quality impacts on the aquifer which supplies the Kane, Chestnut Street, and Cranberry wells. Any discharge of industrial process wastes or other chemicals in this area will be discharged to the ground through septic systems. Since septic systems cannot treat most industrial chemicals (such as volatile organics, heavy metals, etc.) any such discharge within the water supply aquifers could migrate toward one of the public supply wells. Such contamination by organic chemicals has already occurred in the aquifer which supplies

the Kane and Chestnut Street wells. This contamination is being investigated by the town's consultant under a grant from the state Contamination Correction Program. This contamination underscores the vulnerability of the town's water supply to industrial uses located in the aquifer area.

In addition, residential land uses in an unsewered area could pose the threat of groundwater contamination if hazardous household wastes are improperly disposed of.

One of the major concerns for the town's water supply is the proper installation, operation, and maintenance of septic systems, particularly for industrial land uses.

d. Existing Regulations

- o Federal - Industrial wastewater discharges are regulated by the Clean Water Act, which sets standards for discharges through the National Pollution Discharge Elimination System (NPDES) Permit Program. (The NPDES program is implemented jointly by the EPA and the State DEQE. The state has applied for delegation authority).

- o State/town - Disposal of sanitary waste water is regulated by the Board of Health under the State Environmental Code (Title 5) and the town's Board of Health regulations on septic systems. The regulations set requirements for the siting and construction of on-site septic systems, minimum setbacks from wells, and soil properties suitable for septic systems. Equally important to maintaining water quality is the proper operation and maintenance of septic systems. Periodic inspection is necessary, and the septic tank must be pumped out when greases and solids accumulate. However, there are no state or local regulations which require pumping or other maintenance measures.

- o Recommendations. The town should strictly enforce regulations in the watershed areas, and carefully monitor potential problem areas to prevent groundwater contamination which could affect the water supply aquifers. The public should be encouraged through an education program to periodically pump septic tanks and generally maintain septic systems well. The public education effort should especially focus on industrial facilities in the watershed areas, which pose a unique threat to groundwater quality if not properly managed.

3. Road Salt

a. Potential Impacts. Deicing chemicals such as sodium chloride applied to roads in winter or stored in uncovered piles can wash off pavements into surface water. Treatment systems are unable to remove sodium from drinking water; sodium concentrations which may be harmful to the health of some individuals may result. Also, at high concentrations, sodium can corrode water distribution pipes and water fixtures.

Therefore, the Massachusetts Department of Environmental Quality Engineering has set a health standard of 20 mg/1 for sodium. DEQE requires regualar sampling and analysis of sodium concentrations in public water supplies and notification of customers if the concentrations exceed the standard.

b. Land Use Associations. Land uses which are associated with use of road salts are transportation, for maintaining road safety in the winter, and residential, institutional, commercial and industrial, for clearing parking lots and private drives.

c. Existing Conditions. The Hudson Department of Public Works maintains most streets in the town, with the exception of several sections maintained by the state. The state applies a pure salt mixture to an application rate of about 300 pounds per lane-mile. This is applied to upper Washington Street, Brigham Street, and Coolidge Street. None of these are near the main wellfields in the eastern part of town; however, Brigham Street and a small section of I-495 are in the vicinity of the Rimkus well.

The town uses a 5:1 to 8:1 ratio sand-salt mixture on most roads, with an initial application of pure salt on hills and main roads such as Main Street, Lincoln, Central, Broad, Coolidge, and Manning. Of these more heavily salted roads, the only one in close proximity to the wells is Main Street.

The town's use of salt has declined in the last decade with the current level of about 1000 tons per year representing about half the amount of salt used in the mid-1970's. Historic salt use is summarized in Table 4-9.

The town stores its road salt in an open-faced barn at the Cox Street DPW yard. This is out of the main aquifer area, but within the drainage area of the Assabet River. The town has been attempting to get a slat storage shed from the State DPW, which has a program for construction of salt sheds to protect local water resources.

d. Existing Regulations

There are no bylaws or regulations governing the application of road salt.

e. Recommendations

The town should continue to pursue state assistance in obtaining a covered salt shed.

Through its regular drinking water quality tests, the town should monitor sodium levels in each of the wells. If elevated sodium levels are found, the town should consider establishing low salt zones in areas near the wells.

Table 4-9

Use of Road Salt in Hudson, 1973-1984

Year	Salt (tons)	Sand (tons)
1973	1456	3833
1974	1913	2927
1975	2028	4696
1976	2000	4600
1977	2200	6646
1978	1127	5065
1979	1264	5951
1980	871	3072
1981	1410	2867
1982	972	2970
1983	1032	3610
1984	1082	3500

4. Leachate

a. Potential Impacts. Leachate is liquid waste which results when water percolates through buried materials in sanitary landfills, waste impoundments, and other disposal sites. Depending on the characteristics of the buried materials, leachate can contain inorganic and organic contaminants, as well as dissolved solids which can degrade groundwater supplies.

b. Land Use Associations. Land uses which may be associated with leachate generation are classified as waste, industrial and commercial. Waste uses include sanitary landfills and other official dump sites. Industrial and commercial establishments are included because owners may bury wastes from the operations on their property.

Industrial land uses are included because some of these may have waste impoundments as part of their operations.

c. Existing Conditions - There is a privately operated landfill in Hudson which is located near the Assabet River off of Cox Street. This landfill has been used by the town of Stow for the past 5 years, and is currently also being used by Hudson. The current permit will expire in about 6 months when approval will be needed to develop an additional cell.

The landfill has a liner and leachate collection system, but no leachate has been collected since it was installed in 1978. the DEQE suspects that leachate is percolating into the groundwater beneath the landfill. Groundwater monitoring has been conducted, but the original four monitoring wells were not located where they could detect leachate. Recently, three new monitoring wells were installed close to the disposal area. Initial samples indicate elevated levels of iron and specific conductance, but additional sampling needs to be done to determine whether those levels will remain high or stabilize at a lower level. If it is determined that the leachate is contaminating the groundwater, DEQE will probably require the cell to be capped with impervious material.

Hudson has appropriated money to build a temporary transfer station, and the town is investigating its future options for solid waste disposal.

d. Existing Regulations

- o Federal. No regulations concerning sanitary landfills.

- o State. Landfills are operated under the DEQE regulations (310 CMR 19.00). These cover site selection, construction, cover material, litter and dust control, drainage of surface water, and completion and final cover of the landfill.

  New state regulations have been drafted which afford much greater protection to groundwater. The new regulations require an impervious liner, groundwater monitoring, runoff guidance, and landfill capping. Although not formally adopted as state regulations, DEQE has been applying the standards of the new regulations to most new or expanded landfills.

- o Local. The Board of Health has responsibility for assigning sites for sanitary landfills and transfer stations. the Board also has general powers (under Chapter 111 to protect the public health.

e. Recommendations.

The town should continue to monitor the existing landfill for evidence of groundwater contamination.

5. Hazardous Wastes

a. Potential Impact. Hazardous wastes are wastes which are toxic, reactive, corrosive or ignitable. Improper handling of hazardous wastes is an obvious threat to drinking waters; however, federal and state regulations have been enacted to reduce the threat of contamination, including water supply contamination. A less obvious source of hazardous wastes what is commonly referred to as "household hazardous wastes".

These include materials such as bleach, mothballs, paint remover, oven cleaner, wood preservative, and used motor oil. Improperly disposed of, they also can reach groundwater or surface water and result in contamination of supplies. This is especially true in an unsewered area, such as Hudson's water supply watershed. All materials disposed of "down the drain" will reach the groundwater through on-lot septic systems, which are not designed to treat many chemical wastes.

b. Land Use Associations. All developed land use types have the potential to be associated with hazardous wastes. Thirty percent of the town is developed with residential, industrial, and commercial land uses. In addition, transportation corridors are susceptible to accidental spills.

c. Existing Conditions. According to EPA data developed under the hazardous wastes. These are listed in Table 4-10. Seven of these are in close proximity to the Kane and Chestnut St. wells.

d. Existing Regulations.

- o Federal. Hazardous waste generation, treatment, storage, transportation and disposal is regulated by the resource Conservation and Recovery Act (RCRA). The EPA has delegated authority to the state of Massachusetts to carry out the program.

- o State. The Massachusetts Hazardous Waste Management Act (Chapter 21c) and the DEQE hazardous waste regulations (310 CMR 30) establish a system of stringent control over hazardous wastes. All waste generators are registered, and all wastes produced are accounted for in a "cradle-to grave" manifest system. All wastes must be handled by licensed haulers and disposal facilities. There are standards for facilities which treat, store, and dispose of hazardous wastes. Waste generators are classified as Large Quantity Generators if they generate over 1000 kilograms per month of non-acutely hazardous wastes and more than 1 kilogram/month of acutely hazardous wastes. Quantities of waste above the Large Quantity threshold must be removed from the site within 90 days.

- o Town. The town has a Hazardous Waste Bylaw which regulates the use, storage, and disposal of hazardous wastes. See Figure 4-4 for a summary of the major provisions of the bylaw.

Summary

Authority:

MGL Chapter 40, Section 21.

Purpose:

Protect, preserve, and maintain the existing and potential groundwater supply, groundwater recharge areas, and surface water from contamination with hazardous materials.

Regulated materials:

Any substance deemed a hazardous waste in M.G.L. Chapter 21C, or any substance which in the Board of Health's judgement poses a substantial present or potential hazard to the human health, safety, welfare, or the environment.

Registration:

All commercial or industrial establishments (including home occupations) storing more than fifty (50) gallons liquid volume or twenty-five (25) pounds dry weight of hazardous materials must register annually with the Board of Health the types, quantities, location, and method of storage.

Inventory:

Owners/operators must maintain an inventory, reconciled monthly, of purchase, use, sale, and disposal of hazardous materials.

Disposal:

Hazardous wastes must be stored in product-tight containers and removed by a licensed carrier for disposal in accordance with MGL Chapter 21C.

Aboveground storage:

Must be on impervious surface enclosed by a permanent dyke equal to or greater than volume of containers.

Underground storage:
(55 gallongs or more)

Owners must file with Board of Health the size, type, age, and location of each tank.

Tank testing:

Tanks with no evidence of installation date must be tested for tightness. All tanks must be tested 15 years after installation and annually after 20 years.

Tank standards:

New tanks must be protected from corrosion, e.g. fiberglass, steel with bonded fiberglass, STI 3-Way Protection System, etc.

Leakage:

All leaking tanks must be emptied within 12 hours and removed.

Tank location:

New tanks may not be installed within four feet of maximum high water table, or within 100 feet of a surface water body.

Variances:

The Board of Health may vary the application of the bylaw when an equivalent degree of environmental protection will be achieved.

Table 4-10

HUDSON HAZARDOUS WASTE HANDLERS

	Address	Activity[1] Type	Regulatory[2] Status
Accumet Engineering	1 Kane Ind. Dr.	G	2
Accumet Engineering	518 Main St.	G	
Arrow Automotive	555 Main St.	G	
Auto. Components of N.E.	120 Central	G	2
Body & Paint Ctr. of Hudson	Sawyer Lane	G	2
Cassella Auto Body	15 Coolidge	G	2
Datatrol	Brent Dr.	G	2
Diamond Machine Tech.	34 Tower	G	2
* Digitial Equip. Corp.	75 Reed Rd.	*G	4
Ditric Optics	312 Main	G	2
Durand Chevrolet	246 Main	G	2
Hudson Cleaners	91 Main	G	2
Hudson High School	69 Brigham	G	2
Hudson Light & Power	Cherry St.	G	
Hudson Light & Power	49 Forest Av.	G	
Hudson Lock	81 Apsley	G	2
Hypertronics Corp.	16 Brent Dr.	G	2
Intress, Inc.	Kane Ind. Dr.	G	2
Koro Corp.	560 Main	G	2
Lance Corp.	321 Central	G	2
Larosee H. & Sons	15 Broad	G	2
Machinery for Electronics	4 Begelow		1
Prestolite Wire Div.	43 Broad	G	2
Rexnord Knife	571 Main	G	
Sandoz Colors & Chemicals	16 Kane Ind. Dr.		1
Stypher Corp.	34 Tower	G	2
Taylor Rental Center	31 Washington	G	2
Tessier Machine Co.	28 Houghton	TSD	
Torwell Industries	17 Brent Dr.		1
Village Cleaners	Washington St.	G	2

* RCRA Major Handler

[1] Activity Type: G = Generator, TSD = Treat, Store & Dispose

[2] Regulatory Status: 1 Non-regulated (Non-handler)
2 Non-regulated (Small Quantity)
4 Less than 90 day storage
5 Waste not regulated

c. Recommendations. The town should strictly enforce the hazardous waste bylaw in the industrial areas of the watershed. There is a significant potential for groundwater contamination in these areas if hazardous materials are improperly handled, stored, or disposed of.

6. Pesticides

a. Potential Impacts. The term pesticides includes insecticides, herbicides and rodenticides. These are all chemical compounds used to control unwanted organisms such as insects, weeds and rodents. Since the compounds vary depending upon their target organisms, their potential water resources effects also vary greatly. Pesticides may enter water supplies by direct infiltration through the ground or by way of runoff. Water supply impacts may be caused by improper use storage, or disposal of pesticide products. In some locations, even properly regulated application may have the potential to impact water supplies.

b. Land Use Associations. Land uses associated with use of pesticides are residential, institutional, transportation, utility (electrical), and agricultural and recreation. Homeowners use pesticides to control insects, weeds and rodents in gardens and homes. Municipal departments of public works often use herbicides for part or road maintenance. Golf courses often use herbicides and fungicides to maintain the turf.

c. Existing Conditions. Potential sources of pesticides in the aquifer area include agricultural land and a railroad right-of-way for the B & M railroad. Both land uses are in close proximity to the Chestnut Street and Kane wells. It should be noted that the Chestnut Street well has low levels of dichloropropane contamination, which is a potential by product of some pesticides. The source of that contamination is currently being investigated by the town's consultant under the state DEQE Contamination Correction Program.

d. Existing Regulations

- Federal. The EPA tests pesticide products and approves their use, with label instructions for proper use.

- State. Guidelines for right-of-way maintenance are being developed by the Pesticide Bureau of the Department of Food and Agriculture. Two sets of interim guidelines have been issued governing herbicide application. One regulates herbicide use on ballast areas of railroad layouts, and the other addresses herbicide use on both railroad layouts and utility rights-of-way. Both sets of guidelines restrict applications of pesticides to within 400 feet of wells or surface water supplies, including tributary streams. Krenite is to be used between 50 and 400 feet of a water supply source. A 100 foot buffer is

to be left on either side of a railroad ballast where it crosses a stream tributary to a surface water supply.

- o Town. There are no town bylaws or regulations concerning application of pesticides.

e. Recommendations. There are agricultural activities in close proximity to the Chestnut Street well. The town should monitor the use of pesticides in this area, and periodic groundwater sampling in the aquifer should be designed to detect known pesticides in use.

7. Mineral Extractions (Sand and Gravel Mining)

a. Characteristics and Water Supply Impacts. Mining poses a threat to groundwater if the excavation reaches too close to the water table, not leaving a sufficient buffer zone for contaminants to be filtered out. Future land uses on abandoned mines should also be carefully regulated, considering the potential groundwater impacts.

b. Land Use Associations. Mining; sand and gravel excavation.

c. Existing Conditions. There are extensive sand and gravel operations in close proximity to the Chestnut Street and Kane wells. The potential for groundwater impacts depends largely on the depth of excavation relative to the water table, as well as land uses which may be permitted after mining activities have ceased.

d. Existing Regulations.

- o Federal. No regulations.
- o State. No regulations.
- o Town. A Gravel Removal Plan has been developed which regulates the removal of gravel on property near the Chestnut Street well. The plan requires excavation to proceed in three phases, to be completed by 1990. The depth of excavation may not be below four feet above the 100 year flood plain, or to an elevation of 185 feet. Areas previously excavated below the 100 year flood plain (elevation 181) must be backfilled to elevation 181. The plan also prohibits gravel processing or washing operations, servicing or fueling of equipment, dust laying chemicals or salt-based deicing agents, or hazardous or toxic materials on the 44 acre site.

e. Recommendations. The town should amend its Earth removal bylaw to require that the maximum depth of excavation be at least ten feet above the seasonally high water table. The high water table level should be established by soil borings and test wells which are monitored for one year. A proposed bylaw amendment is included in Appendix B.

CHAPTER 5

ZONING - REGULATION OF FUTURE LAND USE

The preceding chapter focused on existing land uses and their potential impact on water supplies. In this chapter, the towns zoning bylaw will be examined in order to determine the potential impacts of future development in the watershed area, and its compatibility with water supply protection.

Zoning determines the type and intensity of development which may occur within defined districts of the town. As such, it isone of the most important tools at the town's disposal to insure the long-term protection of its water supplies. By defining critical water resource areas and restricting future and uses within those areas, the town can insure that incompatible or hazardous land uses do not threaten groundwater quality in the future. Sound management of the land use in the watershed area will not only protect the public health, it will also help prevent a contamination incident which could cost the town millions of dollars in treatment and clean-up costs.

ZONING DISTRICTS

In Hudson, the 1777-acre watershed area falls within portions of six zoning districts (see Table 5-1 and Figure 5-1). Three of these districts are residential, and they cover about 1300 acres or 73 percent of the watershed. About 470 acres, or 26 percent of the watershed is zoned industrial, and 3 acres are zoned commercial. Each of the zoning districts is described below.

Residential. The residence districts within the watershed include tne SA-5 district (40,000 square foot lots), the SA-8 district (30,000 square foot lots), and the SB district (15,000 square foot lots). In addition to housing, other uses permitted in these districts include schools, churches, municipal buildings, farms, nurseries, professional offices in private residences, and home occupations and crafts. Uses allowed by special permit include golf courses, campgrounds, cemeteries, greenhouses, hospitals, nursing homes, riding stables, and water or sewer pumping stations.

The potential impacts on water supplies of the residential districts include reduction of groundwater recharge due to impervious surfaces; use of road salts, pesticides, and fertilizers which can introduce contaminants into groundwater, wastewater affluent from septic systems, and underground storage of heating oil. Improper disposal of household hazardous wastes may also pose a threat to groundwater.

Table 5-1

ZONING BYLAW
Density Requirements and Area within the Watershed

District	Min. Lot Area (sq. feet)	Area in Watershed (acres)	Percentage of
Residential			
SA 5	40,000	803	45.0
SA 7	30,000	---	----
SA 8	30,000	425	24.0
SB	15,000	76	4.3
SB 1	15,000	---	----
SB 2	5,000	---	----
Commercial			
C-1-13	15,000*	3	0.2
Industrial			
M-1,2,3,4,5	30,000	43	2.5
M-6	30,000	427	24.0
M-7	30,000	---	----
TOTAL	---	1,777	100%

* For a dwelling unit.

FIGURE 5-1

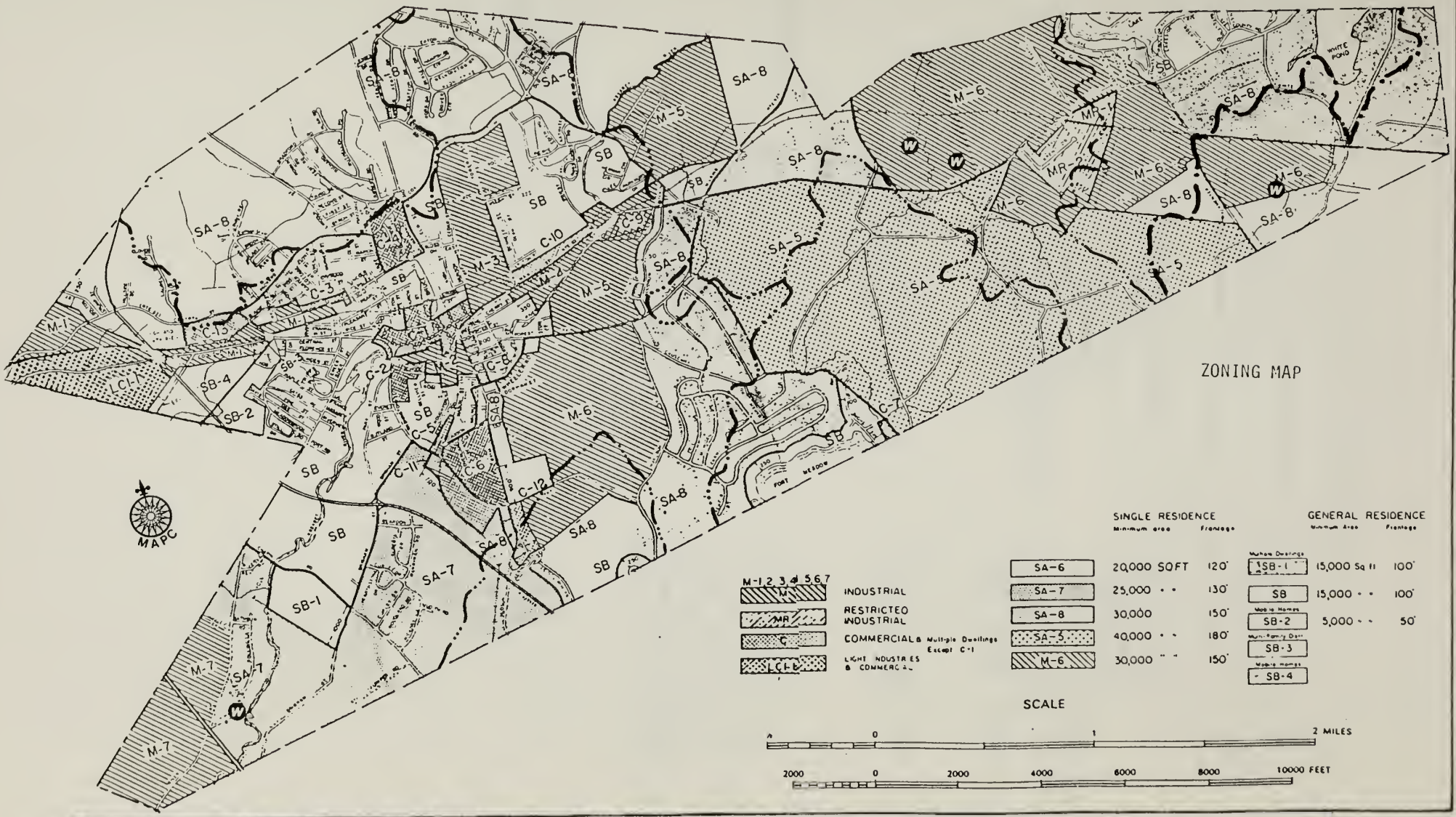

ZONING MAP
MAPC
M-1,2,3,4,5,6,7 M INDUSTRIAL
MR RESTRICTED INDUSTRIAL
C COMMERCIAL & Multiple Dwellings Except C-1
LCI-E LIGHT INDUSTRIES & COMMERCIAL
SINGLE RESIDENCE
Minimum Area Frontage
SA-6 20,000 SQFT 120'
SA-7 25,000 " " 130'
SA-8 30,000 150'
SA-5 40,000 " " 180'
M-6 30,000 " " 150'
GENERAL RESIDENCE
Minimum Area Frontage
SB-1 Multiple Dwellings 15,000 Sq ft 100'
SB Multiple Dwellings 15,000 " " 100'
SB-2 Mobile Homes 5,000 " " 50'
SB-3 Multi-Family Dwellings
SB-4 Mobile Homes
SCALE
0 1 2 MILES
2000 0 2000 4000 6000 8000 10000 FEET

Figure 5-2

Zoning Bylaw Use Regulations

Zoning District	Permitted Uses	Special Permit Uses
Residential	Single family dwelling Church, school, Municipal buildings Parks, playgrounds Farm, garden, nursery Professional office/residence Home occupation/crafts Accessory Uses	Golf course Campground Town cemetary Commercial greenhouse Hospital, nursing home Riding stable Water/sewer pumping station
Commercial	Business, service, public utility Uses permitted in Residence District Agriculture, horticulture	Multiple dwellings (except C-1)
Floodplain/wetland	Conservation Outdoor recreation Grazing/farming Forestry/nurseries Temporary structures Pre-existing dwellings	Any use permitted in underlying district (Upon recommendations of Planning Board, Conservation Commission, and Board of Health)

Note: Prohibited in all districts: Self Service Gasoline Stations.

Commercial. There is a three acre commercial district located in the southern portion of the watershed on the Marlborough border. This district permits those uses allowed in the residence district in addition to businesses, services, or public utilities. Multiple dwellings are allowed by special permit.

Due to its small size and remote location with respect to the town's wells, this district does not pose a significant threat to the water supplies.

Industrial. Over one-fourth of the watershed is zoned industrial. This includes 427 acres of the M-6 district and 43 acres of the MR district. These districts allow industry and manufacuring as well as agriculture and horticulture. The M-6 district also allows uses permitted or allowed by special permit in a residential or commercial district.

The portions of the watershed which are zoned industrial are in the immediate proximity of the three wells and the aquifers which contribute to them. In fact, the three wells themselves are located on industrially zoned land. This poses a significant threat to the long-term quality of the town's water supplies. This threat is exacerbated by the fact that this area relies on on-site septic systems for the disposal of wastewater. All wastes disposed of by industries in the watershed are discharged to the groundwater in close proximity to the town wells.

As mentioned previously, organic chemical contamination has already been discovered in the aquifer. The potential for future perhaps more serious contamination can be reduced by restricting future industrial growth in the watershed.

RECOMMENDATIONS

In order to address the potential future threats to water supplies identified in this chapter, an amendment to the town's zoning bylaw is recommended. This amendment would establish a Watershed Protection Overlay District for the entire watershed area which flows towards the town's wells.

Watershed Protection Overlay District. In order to protect the entire watershed from potential sources of contamination, a Watershed Protection Overlay district is recommended. This measure would not change the zoning districts, but it would add an "overlay" of additional protection measures within a defined district, in this case the watershed area (see figure 5-1). Within this area, certain hazardous uses, such as landfills, salt storage, storage of hazardous materials, and underground storage of petroleum would be prohibited. Other activities, such as application of pesticides and fertlizers for non-agricultural uses, residential construction on lands with slope exceeding 12 percent, and industrial and commercial uses would be allowed by special permit (see Appendix B.)

CHAPTER 6

SUMMARY OF FINDINGS AND RECOMMENDATIONS

This study has examined the potential water quality impacts of existing land uses and of potential future land uses permitted under the current zoning bylaw. Throughout the analysis, recommendations were presented to mitigate the various water quality impacts identified. These various recommendations can be drawn together into a comprehensive water supply protection program as outlined below.

WATER SUPPLY PROTECTION PROGRAM

Zoning

(a) Findings. The industrial zoning in part of the watershed area near the Kane, Chestnut Street, and Cranberry wells poses a threat to the long-term quality of a major portion of the town's potable water supply sources. All wastewater from industries in this area is discharged to groundwater in the vicinity of the town's wells. Organic chemical contamination has already occurred in this area, underscoring the danger of uncompatible industrial land uses in the watershed areas.

(b) Recommendations. In order to increase the level of protection throughout the watershed areas, it is recommended that a Watershed Protection District be established as an overlay zone. This amendment would not change the existing zoning districts but it would impose additional conditions and requirements within the watershed areas in order to minimize potential water quality impacts. These include the prohibition of uses such as landfills and storage or handling of hazardous wastes. Other uses would be allowed by special permit, such as commercial and industrial uses permitted in the underlying district, the application of fertilizers and pesticides for non-agricultural uses, and construction on slopes greater than 12 percent. This amendment would allow existing uses to continue as non-conforming uses.

This zoning amendment addresses the most critical threats to the long-term quality of Hudson's drinking water. It would control potential sources of contamination both in the immediate area of the wells and throughout the watershed. This is the highest priority recommendation of this study.

Underground Fuel storage

(a) Findings. Commercial and residential underground fuel storage tanks in the watershed areas are a long-term threat to water quality due to potential leaks and petroleum contamination of groundwater. New state regulations (527 CMR 9) provide more stringent regulation of larger commercial tanks, but smaller tanks (less than 1100 gallons) are exempted from most regulations.

In addition, the town's records of underground fuel tanks are incomplete for some of the older tanks, and the records are divided between the Selectmen's office (which grants licenses) and the Fire Department (which grants permits).

(b) Recommendations. The town should establish a uniform registry of all underground fuel tanks, combining information from the Selectmen's licenses and the Fire Department's permits. Data from the new registrations required by the amended state Fire Prevention Regulations should be added as it becomes available. The inventory could note which tanks are located within the watershed areas so these can be carefully monitored.

It is recommended that the town adopt an undergound fuel storage bylaw which:

- o requires a permit for those tanks exempted by state regulations;
- o requires periodic tightness testing for tanks exempted by state regulations which are located in the watershed areas; and
- o allows the Board of Health, Water Department, and Conservation Commission to review requests for permits or licenses for new tank installations, and advise the permit or license granting authorities on any possible water supply impacts and suggested mitigation measures.

A recommended bylaw is included in Appendix C.

Earth Removal

(a) Findings. Excavation to a depth below ten (10) feet above the water table has potential impacts on groundwater quality and quantity. Excavating too close to the water table can also place constraints on the development of an area for other uses after excavation activities have terminated.

(b) Recommendations. The town's Earth Removal Bylaw should be amended to require a ten (10) foot buffer above the seasonal high water table. The elevation of the water table should be established through soil borings and test wells which are monitored for at least one year.

A recommended bylaw amendment is included in Appendix D.

Junkyard Regulation

(a) Findings. An existing junkyard in close proximity to the municipal wells may pose a threat to water quality if it is not properly operated and maintained. Junkyards have contaminated groundwater in other Massachusetts communities.

(b) Recommendations. Periodic monitoring of conditions at the junkyard by the Board of Health could insure proper operating conditions. Evidence of spills, leaks, or storage or disposal of potentially hazardous materials should be followed up by soil or water samping and testing.

Groundwater Monitoring

(a) Findings. The existence of industrial facilities near the town's wells and the organic chemical contamination which has already occurred indicates that potable water sources may already be endangered. An engineering study is currently being conducted to identify the causes of contamination. As part of that investigation, a series of monitoring wells have been installed throughout the aquifer.

(b) Recommendations. It is recommended that the town establish an ongoing groundwater monitoring program in the water supply aquifers. Groundwater should be sampled from observation wells located to intercept groundwater flow between industrial land uses and the municipal wells. A groundwater monitoring program, including observation well location, frequency of samping, and water quality parameters to be sampled and tested for should be obtained from an engineering consultant. The monitoring which is currently being conducted may be useful as a foundation for a permanent monitoring program. This program will allow the town to identify contaminants before they reach the wells, and provide the opportunity to take remedial action to save a well threatened with contamination.

APPENDIX A
WATERSHED PROTECTION DISTRICT

To see if the Town will vote to amend the Protective Zoning Bylaws of the Town of Hudson pursuant to the provisions of Chapter 40A of the General Laws, by inserting a new section as follows:

SECTION V-1 WATERSHED PROTECTION DISTRICT

SECTION I

Purpose of District

A. A Watershed Protection District is established in the Town of Hudson for the following purposes.

1) to preserve and protect the lakes, ponds, streams, brooks, mills, marshes, swamps, bogs, and other waterbodies and water courses in the town;

2) to protect, preserve and maintain the water table and water recharge areas within the town, so as to preserve present and potential sources of water supply for the public health and safety;

3) to protect the community from the detrimental use and development of land and waters within the watershed protection district; and

4) to conserve and watershed areas of the Town of Hudson for the health, safety, welfare, and enjoyment of its people.

SECTION II

Establishment and Definition of District

A. The intent of the Watershed Protection District is to include lands lying adjacent to water courses and surface water bodies, as part of their natural drainage system. The district includes all areas designated on the Watershed Protection District Maps for the Town of Hudson, on file in the Office of the Town Clerk, which are hereby made part of the town zoning map(s) [plus all land lying within 25 feet from the normal highwater line of lakes, ponds, marshes, swamps, bogs, brooks, streams and rivers].

B. The Watershed Protection District is an overlay district and shall be superimposed on the other districts established by this bylaw. No uses not permitted in the portions of the districts so overlaid shall be permitted within the district.

SECTION III

Permitted Uses

A. The following uses are permitted within the watershed protection district, subject to Section IV, provided that all necessary permits, orders, or approvals required by local, state or federal law shall also be obtained.

(1) conservation of soil, water, plants, and wildlife;

(2) outdoor recreation, nature study, boating, fishing, and hunting where otherwise legally permitted;

(3) boat docks, landings, foot, bicycle and/or horse paths and bridges;

(4) proper operation and maintenance of existing dams, splash boards, and other water control, supply and conservation devices;

(5) residential development, as permitted in the underlying district, with a maximum density of (two) units per acre, providing that the average slope of each lot shall not exceed 12%;

(6) repair, maintenance and reconstruction of structures and uses lawfully existing prior to adoption may be continued as permitted under the Zoning Act. Existing dwellings may be expanded provided ground coverage is not increased more than 50%; and

(7) farming, gardening, nursery, conservation, forestry, harvestry, and grazing.

SECTION IV

Prohibited Uses

A. The following uses are prohibited within the watershed protection district:

(1) the location of landfills and the storage of salt and road de-icing chemicals;

(2) any building, structure, land-disturbing activities, or excavations within 25 feet from the normal highwater line of all water bodies and courses within the watershed protection district;

(3) any animal feedlots, or pastures, or confinement areas, or storage of manure, or drainage from such activities, within 25 feet from the seasonal highwater line of all water bodies and courses within the watershed protection district;

(4) the disposal of solid waste, other than brush;

(5) the storage and/or sale of petroleum (or any other refined petroleum product) except within the buildings which it will heat;

(6) the dumping of snow contaminated by de-icing chemicals which is brought in from outside the district;

(7) the storage or disposal of hazardous materials, as defined by the Hazardous Waste Board, the Water Resources Commission, and the Division of Water Pollution Control under the provisions of Section 27(8), 52, and 58 of Chapter 21 of the General Laws.

SECTION V

Special Permit Uses

A. The Board of Zoning Appeals may allow the following uses, Subject to Section IV, within the Watershed Protection District, hereof and subject to any additional conditions the Board of Zoning Appeals may impose.

(1) those commercial and industrial activities permitted in the underlying district, with a site plan review;

(2) the construction of dams or other water control devices; including the temporary alteration of the water level for emergency or maintenance purposes and periodic cleaning;

(3) conditions under which ponds or pools or other changes in water bodies or courses, created for swimming, fishing, or other recreational uses, agricultural uses, or drainage improvements, may be undertaken;

(4) the application of pesticides for non-agricultural uses in combination with erosion and sedimentation control plans, provided that all necessary precautions shall be taken to prevent hazardous concentrations of pesticides in the water or the land within the watershed protection district as a result of such application. Such precautions include, but are not limited to, erosion control techniques, the control of runoff water (or the use of pesticides having low solubility in water), the prevention of volatilization and redeposition of pesticides and the lateral displacement (i.e. wind drift) of pesticides; and

(5) the application of fertilizers for non-agricultural uses in combination with erosion and sedimentation control plans provided that such application shall be made in such a manner as to minimize adverse impacts on surface and groundwater due to nutrient transport and deposition and sedimentation.

(6) residential construction upon a lot with an average slope exceeding 12%.

SECTION VI

Procedures for Issuance of Special Permit

A. Each application for a special permit shall be filed with the Board of Zoning Appeals and shall be accompanied by 3 copies of the plan.

B. Said application and plan shall be prepared in accordance with the data requirements of the proposed development (e.g. site plan review, erosion, and sedimentation control plan, etc.)

C. The Board of Zoning Appeals shall refer copies of the application to the Board of Health, the Conservation Commission, and Town Engineer/Department of Public Works, and the Planning Board. These boards/departments shall review, either jointly or separately, the application and shall submit their recommendations.

Failure to make recommendations within 35 days of referral of the application shall be deemed lack of opposition.

D. The Board of Zoning Appeals shall hold a hearing, in conformity with the provisions of the Massachusetts General Laws Chapter 40A, Section 9 within 65 days after the filing of the application and after, the review of the aforementioned town boards/departments recommendations.

Notice of the public hearing shall be given by publication and posting and by first-class mailings to "parties in interest" as defined in the Massachusetts General Laws Chapter 40A, Section 11. The decision of the Board of Zoning Appeals and any extension, modification, or renewal thereof, shall be filed with the Board of Zoning Appeals and Town Clerk within 90 days following the closing of the public hearing. Failure of the Board of Zoning Appeals to act within 90 days shall be deemed a granting of the permit. However, no work shall commence until a certification is recorded as required under said Section 11 of Chapter 40A.

E. After notice and public hearing, and after due consideration of the reports and recommendations of the Planning Board, the Board of Health, the Conservation Commission and Town Engineer/ Department of Public Works, the Board of Zoning Appeals may grant such a special permit provided that it finds that the proposed use:

(1) is in harmony with the purposes and intent of this by-law and will promote the purpose of the Watershed Protection District;

(2) is appropriate to the natural topography, soils, and other characteristics of the site to be developed;

(3) will not, during construction or thereafter, have an adverse environmental impact on any water body or course in the district; and

(4) will not adversely affect an existing or potential water supply.

SECTION VII

Limit of Authority

This district does not limit the existing authority of the Conservation Commission pursuant to Section 40 of Chapter 131 of the General Laws.

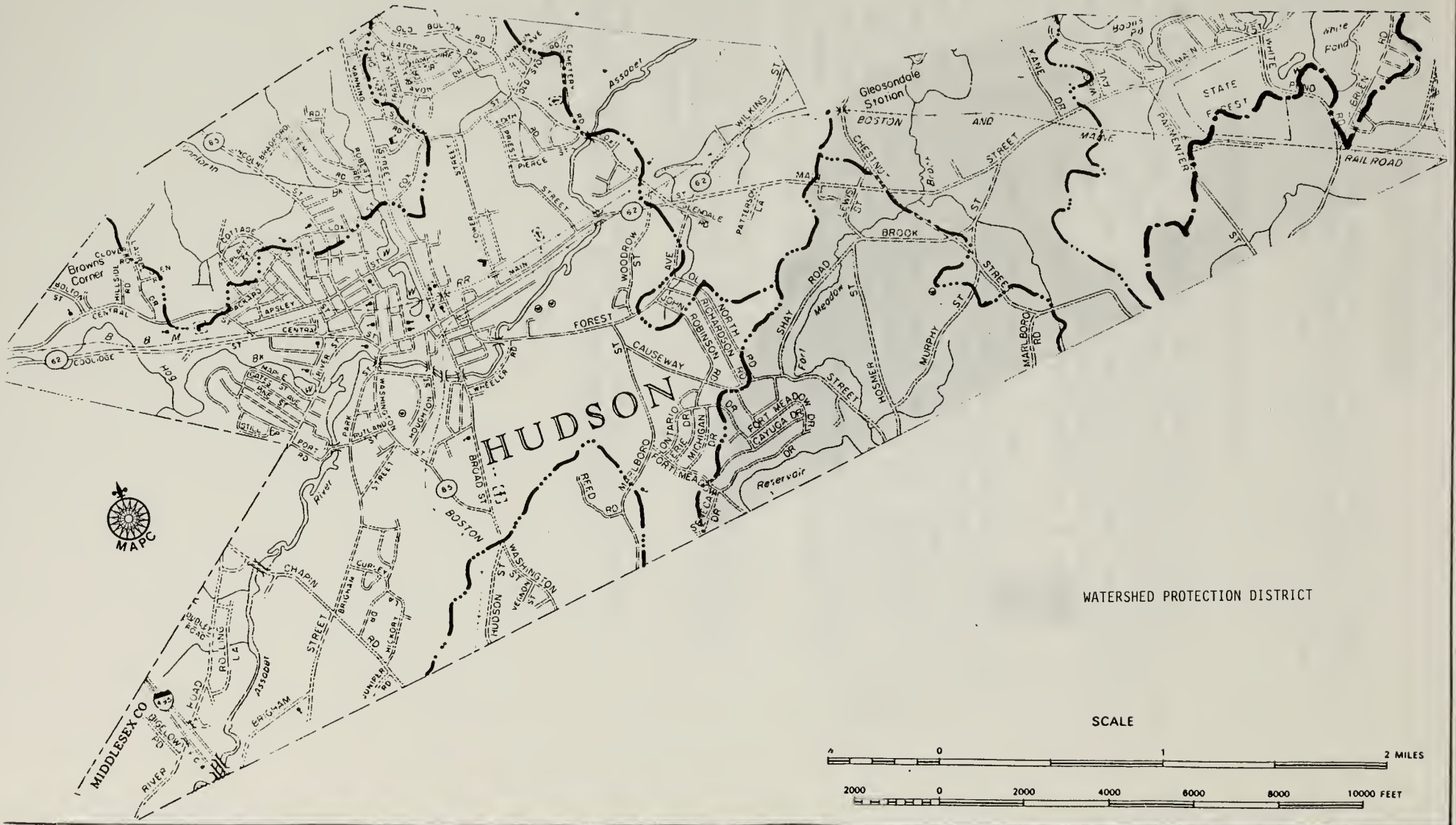
SECTION VIII

Development Regulations

All construction and land disturbing activities within the watershed protection district shall be designed or sited to minimize erosion and runoff by adhering to the practices outlined in "erosion and Sediment control in Site Development the Massachusetts Conservation Guide" (U.S. Department of Agriculture Soil Conservation Service, Amherst, MA) to include minimizing the construction period, slope stabilization, ditch maintenance, filtering , sedimentation basins, and revegetation.

Or take any action relative thereto.

Town of Hudson: Watershed Protection Overlay District



APPENDIX B

HUDSON TOWN BY-LAW -- UNDERGROUND FUEL STORAGE

To see if the Town will vote to amend its by-laws by adding, pursuant to the Town's home rule powers, police powers to protect the public health, safety and welfare, and Mass. General Laws, Chapter 40, Sec. 21, the following section:

"Regulation of Underground Fuel"

(1) Any person, corporation or other entity intending to install an underground fuel storage facility exempt from state regulations (such as farm or residential tanks 1100 gallons or less used for storing motor fuel and tanks used for storing heating oil for consumptive use on the premises were stored) in the Watershed Protection District shall first apply to the Hudson Fire Department for a permit.

(2) Upon receipt of such a permit application under section (1) of this by-law or any other fuel storage application under the State Fire Prevention Code (527 CMR), the Fire Department, Board of Selectmen or other permitting authority shall forward copies of same to the Conservation Commission, Board of Health and Water Department. Each board may make a recommendation of approval or disapproval, including suggested mitigation or conditions, within thirty (30) days. Failure to make a recommendation shall not affect the authority of the Fire Department, Board of Selectmen or other appropriate permitting authority to act on an application.

(3) A tightness test shall be required for each fuel storage tank exempted from state regulations within the Watershed Protection District in the manner prescribed for other tanks in 527 Code of Massachusetts Regulations 9.

(4) In construing the by-law, resort may be had to the State Fire Prevention Code (527 CMR9) to the extent applicable.

or take any other action relative thereto.

APPENDIX C
EARTH REMOVAL BYLAW AMENDMENTS

To see if the Town will vote to amend the Earth Removal By-Town of Hudson, Article VI, Section 25, by inserting the following sub-section in Sub-Section 25.2d:

(6) The proposed depth of excavation and the elevation of the annual high water table, as determined by test pits and soil borings, monitored for at least one (1) year.

and by inserting the following sub-section in Sub-Section 25.5b:

(12) Excavation shall not be made lower than ten (10) feet above the annual high water table.

Or take any action relative thereto.